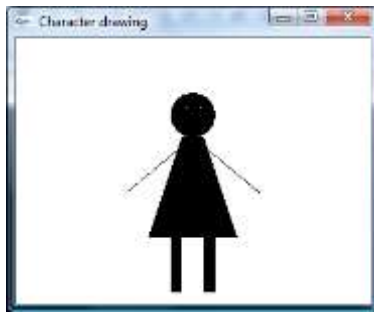


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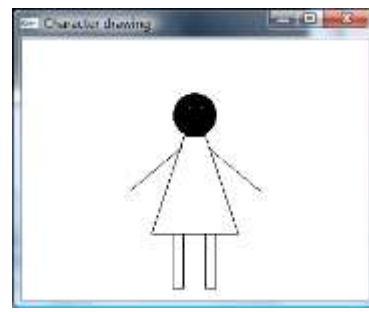
# OpenGL primitives

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1. Explain with examples when possible: OpenGL graphics library functions can be generally classified into primitive functions, attribute functions, viewing functions, transformation functions, input functions, control functions and query functions
2. OpenGL output is strictly specified and will be predictable when we model our objects using *simple, convex and flat* polygons. What is a flat polygon? What is a simple polygon? What is a convex polygon? Give example in drawing when possible.
3. Write an OpenGL program to draw the following symbolic characters.



(a)



(b)

4. Sierpinski gasket is an interesting shape that has a long history and is of interest in areas such as fractal geometry. It is an object that can be defined recursively and randomly; in the limit, however, it has properties that are not at all random. In its two dimensions version, it's formed using three points in the plane  $z = 0$ , let these points be specified as  $(x_1, y_1, 0)$ ,  $(x_2, y_2, 0)$ , and  $(x_3, y_3, 0)$ . The construction of the gasket proceeds as follows:
  - 1) Pick an initial point  $(x, y, z)$  at random inside the triangle.
  - 2) Select one of the three vertices at random.
  - 3) Find the location halfway between the initial point and the randomly selected vertex.
  - 4) Display this new point by putting some sort of marker, such as a small circle, at the corresponding location on the display.
  - 5) Replace the point at  $(x, y, z)$  with this new point.
  - 6) Return to step 2.

Thus, each time that we generate a new point, we display it on the output device. This process is illustrated in the figure below, where  $p_0$  is the initial location and  $p_1$  and  $p_2$  are the first two locations generated by the above algorithm. Write a program that draws a two dimensions Gasket starting from a three points triangle specified by  $\{0.0, 0.0\}$ ,  $\{25.0, 50.0\}$ ,  $\{50.0, 0.0\}$  in considering the initial point inside the triangle (step 2) as  $\{7.5, 5.0\}$  and do the repetition (step 6) 5000 times

